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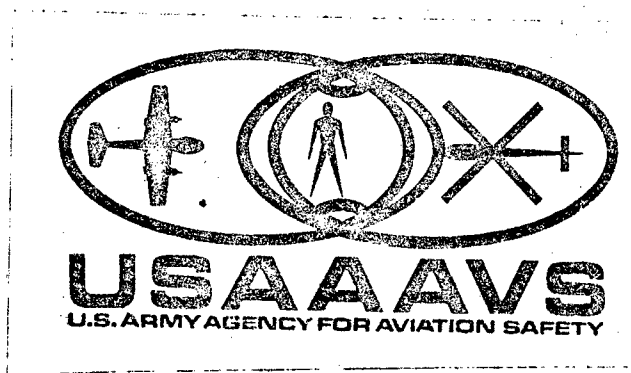
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UH-1 MATERIEL MALFUNCTION/FAILURE MISHAP EXPERIENCE

1 July 1973 - 31 July 1977

Applied Research Division
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FORT RUCKER AVIATION CENTER

UH-1 MATERIEL MALFUNCTION/FAILURE MISHAP EXPERIENCE

1 July 1973 - 31 July 1977

SUMMARY

A statistical review of 746 UH-1 mishaps caused by materiel malfunction/failure was conducted. Summary of results are shown in Table 1.

- Seven or 37% of 19 UH-1 mishaps classified as accidents were caused by malfunction/failure of materiel.

- A majority (98%) were classified as forced or precautionary landing.

- A third (32%) of all precautionary landings were caused by four parts (a hydraulic pressure switch, the aircraft battery, servo cylinders and submerged fuel pumps).

- Mishaps remain essentially the same during the study period while flying hours decreased causing an increase in mishap rates.

- Materiel malfunction/failures reported as the cause of precautionary landings show no capacity to become the cause of a major accident.

- EIR's were submitted for 86% of the reported materiel malfunctions/failures.

- 97% of the mishap reports did not contain information needed to determine what caused or allowed the materiel malfunctions/failures to occur.

CONCLUSIONS

The high materiel mishap rate of the study period of 146.9/100,000

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hours does not indicate that the UH-1 is an unreliable aircraft. Its mishap experience is marked, not by materiel malfunctions/failures that are catastrophic in terms of damage to the aircraft or injury to personnel, but by the inconvenience caused by its high number (98%) of precautionary and forced landings.

A ~~large portion~~ ~~(One-third)~~ of materiel mishaps could be prevented by concentrating effort on 4 parts - hydraulic pressure switch, the aircraft battery, servo cylinders and submerged fuel pumps.

Materiel caused mishaps show an increasing trend ~~over the study period.~~

EIR submission on materiel malfunctions/failures has not brought about any noticeable improvement in the UH-1 mishap experience.

There is a weakness in the Army mishap reporting procedure which does not require cause factors of materiel caused forced and precautionary landings to be submitted.

RECOMMENDATIONS

Action taken to improve the reliability of the four parts that caused one third of the materiel caused mishaps during the study period.

Action taken to cause the UH-1 EIR program to produce beneficial results.

Action taken to expend a level of effort needed to investigate forced and precautionary landings to determine what caused or allowed the materiel malfunction/failure to occur.

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UH-1 MATERIEL MALFUNCTION/FAILURE MISHAP EXPERIENCE

This summary report presents a statistical review of the Fort Rucker UH-1 mishaps caused by materiel malfunction/failure during the 49 month period of 1 July 1973 through 31 July 1977.

For purposes of this report a materiel malfunction/failure is defined as being the malfunction/failure found by the investigators reported to U.S. Army Agency for Aviation Safety (USAAAVS) IAW AR 385-40 and outlined in AR 95-5.

Discussion/Results

UH-1 mishaps occurred at a rate of 162.2/100,000 hours during this period. A total of 824 mishaps were reported to USAAAVS. Of this total 746 were caused by materiel malfunction or failure. These mishaps occurred at a rate of 146.9/100,000 flying hours. A breakout of the UH-1 mishap experience, by classification and for each fiscal year, is shown in Table 2. The materiel caused mishaps are included in this table.

General

Of the 824 UH-1 mishaps reported over the 49 month period, 746 or 90% were caused by materiel malfunction/failures.

Of the 19 UH-1 accidents, 7 or 37% were due to materiel malfunction/failure.

Of the remaining 739 materiel caused mishaps

- 7 (0.9%) were incidents
- 14 (1.9%) were forced landings
- 718 (97.2%) were precautionary landings.

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Figures 1, 2, 3, and 4 place the UH-1 mishap experience in perspective.

Figure 1, which compares the number of flying hours with the number of materiel caused mishaps by quarters at Fort Rucker, shows an increasing trend in materiel malfunctions/failures and a decreasing trend in flying hours.

Figure 2 compares the number of flying hours with the number of materiel caused mishaps by quarters other than Fort Rucker. This figure shows an increasing trend in materiel malfunctions/failures and a steady trend in flying hours.

Figure 3 represents a comparison of the rates of materiel caused mishaps with total UH-1 mishaps at Fort Rucker. The trend lines show that the materiel caused mishaps are approaching the total mishaps. This indicates that while other causes are being reduced the materiel causes are increasing. The increasing trend is due largely to the electrical system, specifically the aircraft battery, malfunctions/failures in FY 76-4 and FY 7T and the hydraulic system in FY 76-1. The hydraulic system subsystems that caused the increase were the servo cylinders, a pressure switch and the irreversible valve.

Figure 4 represents a comparison of the rates of materiel caused mishaps with total UH-1 mishaps other than Fort Rucker. The trend lines show that the materiel caused mishaps show an increase but are still well below that of total mishaps indicating that other cause factors have not been reduced.

For the study period, 93% of materiel causes were attributed to 6 systems (shown in Table 3).

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TABLE 3

	<u>Percent</u>	<u>Acc</u>	<u>Inc</u>	<u>F/L</u>	<u>P/L</u>	<u>Total</u>
Hydraulic	24.9%	-	-	-	186	186
Engine/Power Plant	20.7%	3	1	14	137	155
Electrical	16.9%	-	-	-	126	126
Rotor/Transmission	15.0%	3	2	-	107	112
Fuel System	9.4%	-	-	-	70	70
Instrument	6.4%	-	-	-	48	48
Total	93.3%	6	3	14	674	697

The seven materiel caused accidents were attributed to:

- Fuel manifold in the combustion section of the engine.
- Fuel control regulator in the engine.
- Cross tube of the landing gear skids (minor) accident.
- Clutch on the free wheeling unit of the rotor-transmission system
- Wheel disc of the turbine section of the engine
- Two due to main drive shaft, engine to transmission
- Of the 718 precautionary landings, 229 or 32% were caused by the four parts listed in Table 4.

Hydraulic System

The hydraulic system malfunction/failures were the cause of 186 or 24.9% of the 746 UH-1 materiel caused mishaps. Figure 5 shows a very slight increasing trend over the study period, with the last four quarters showing a decline. The highest rate of 97.6/100,000 hours was achieved during first quarter FY 76. This large increase was due to increased malfunction/failure of the flight controls during this quarter. The

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malfunctions/failures were in the pressure switch, the irreversible valve and the servo cylinders. The lowest rate occurred during 2nd quarter FY 74 of 16.2/100,000 hours. Hydraulic system materiel caused mishaps for the entire period occurred at a rate of 36.6/100,000 hours. This system accounted for 186 precautionary landings or 26% of the UH-1 materiel caused precautionary landings.

91 or 49% of the materiel caused hydraulic mishaps were a result of the malfunction/failure of a pressure switch (FSN 5930-00-646-3495). This represents 13% of the UH-1 materiel caused precautionary landings.

Engine/Power Plant System

The engine/power plant system malfunctions/failures were the cause of 155 or 20.8% of the UH-1 materiel caused mishaps. Figure 6 shows a slight increasing trend over the study period. The highest rate of 56.1/100,000 hours occurred in 2nd quarter FY 76. The lowest rate of 20.1/100,000 was achieved in FY 7T. Engine/power plant system materiel caused mishaps, for the entire period, occurred at a rate of 30.5/100,000 hours. This system accounted for:

- 3 accidents or 43% of the UH-1 materiel caused accidents
- 1 incident or 17% of the UH-1 materiel caused incidents
- 14 forced landings or 100% of the UH-1 materiel caused forced landings
- 137 precautionary landings or 19% of the UH-1 materiel caused precautionary landings.

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Within the engine/power plant system 104 (86%) of the materiel malfunctions/failures were caused by five subsystems:

	<u>Acc</u>	<u>Inc</u>	<u>F/L</u>	<u>P/L</u>
30 Lubrication	0	0	0	30
28 Fuel control/regulator	1	0	3	24
26 Accessory drives	0	0	0	26
14 Compressor	0	0	0	14
6 Turbine	1	1	0	4

The engine lubrication system was responsible for 30 or 4% of the 718 UH-1 precautionary landings. Within this subsystem, 11 oil cooler malfunctions/failures accounted for 37% of that total.

The engine fuel control/regulator was responsible for 1 or 14% of the materiel caused accidents, 3 or 21% of the materiel caused forced landings, and 24 or 3% of the materiel caused precautionary landings.

The accessory drive system accounted for 26 or 4% of the materiel caused precautionary landings. Tach drive problems caused a majority, 22, of the 26 accessory drive system.

The compressor subsystem accounted for 14 or 2% of materiel caused precautionary landings.

The turbine section, although only responsible for 6 total mishaps, accounted for 1 or 14% of the materiel caused accidents, and 1 or 2% of the materiel caused forced landings. The other four mishaps were precautionary landings. The accident was caused by a wheel disc in the turbine section.

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Electrical System

The electrical system malfunctions/failures were the cause of 126 or 17% of UH-1 materiel caused malfunctions. Figure 7 shows a significant increasing trend over the study period despite the last three quarters declining. The highest rate of 73.8/100,000 hours occurred in FY 7T quarter. The lowest rate of 6.9/100,000 was achieved in 2nd quarter FY 74. Electrical system materiel caused mishap for the entire period occurred at a rate of 24.8/100,000 hours. All the mishaps were precautionary landings.

FY 74-4 and FY 7T of Figure 7 indicates a sharp increase which also raises the total rate. This is due to the aircraft battery. In both of these quarters Fort Rucker experienced 14 battery malfunctions/failures. The other quarters in the study period only had 0 to 4 battery malfunctions/failures.

Within the electrical system, 124 or 98% of its materiel caused mishaps were attributed to:

- 48 Battery
- 45 Emergency Warning Systems
- 16 Power DC
- 15 Power AC

The 48 battery malfunctions/failures represent 6% of all malfunctions/failures that occurred during the study period.

Rotor Transmission

The rotor/transmission system malfunctions/failures were the cause of 112 or 15% of the 746 UH-1 materiel caused mishaps. Figure 8 showed

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a slight increasing trend. The highest rate, 40.6/100,000 hours, was obtained in 3d quarter, FY 74. A 4.4 rate was obtained in 1st quarter, FY 74. Rotor/transmission materiel caused mishaps for the entire period occurred at a rate of 22.0/100,000 hours.

This system accounted for:

- 3 accidents or 43% of the materiel caused accidents
- 2 incidents or 29% of the materiel caused incidents
- 107 precautionary landings or 15% of the materiel caused precautionary landings.

Within the rotor/transmission system, two subsystems, the main transmission and tail rotor gear boxes, accounted for 84 or 75% of the 112 materiel malfunctions/failures. All were precautionary landings. The main transmission accounted for 59% of the rotor/transmission materiel malfunctions/failures and 9% of all materiel malfunctions/failures. In the main transmission, the lubrication system was responsible for 69% of the main transmission malfunctions/failures and 6% of the total materiel malfunctions/failures.

Fuel System

The fuel system malfunctions/failures were the cause of 70 or 9% of the 746 UH-1 materiel caused mishaps. Figure 9 shows a steady increasing trend. The highest rate of 28.1/100,000 occurred in 1st quarter FY 77. The lowest rate of 2.5/100,000 hours was achieved the 2nd quarter FY 75. Fuel system materiel caused mishaps for the entire period occurred at a rate of 13.8/100,000 hours.

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Within the fuel system 65 or 93% of the malfunctions/failures which resulted in 9% of the 718 UH-1 precautionary landings were attributed to the main fuel tank.

Instrument System

The instrument system malfunctions/failures were the cause of 48 or 6% of the 746 UH-1 materiel caused mishaps. Figure 10 shows an increasing trend. The highest rate, 25.9/100,000 hours, was obtained in 3d quarter FY 76. A zero rate was reached in 3d quarter FY 75.

Instrument materiel caused mishaps for the entire period occurred at a rate of 24.8/100,000 hours.

Within the instrument system, 30 or 63% of the malfunctions/failures which resulted in 4% of the 718 UH-1 precautionary landings were attributed to:

- 13 Transmission Oil Pressure Gauges
- 11 Engine Oil Pressure Gauges
- 6 Eng Tachometers.

TABLE 1

FY	<u>Accidents</u>		<u>Incidents</u>		<u>Forced Landing</u>		<u>Precautionary Landing</u>		<u>Total</u>	
	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*
77**	0	0.0	4	3.5	2	1.8	198	174.7	204	180.0
76	3	3.1	0	0.0	3	3.1	179	184.3	185	190.5
75	2	1.5	0	0.0	6	4.6	175	133.6	183	139.7
74	2	1.2	3	1.8	3	1.8	166	99.8	174	104.6
Total	7	1.4	7	1.4	14	2.8	718	141.4	746	146.9

*Per 100,000 flying hours

**FY 77 include FY 7T and FY 77 thru 31 July 77

TABLE 2

UH-1 MISHAP EXPERIENCE

FY	FH	<u>Accident</u>		<u>Incident</u>		<u>Forced Landing</u>		<u>Precautionary Landing</u>		<u>Total</u>	
		No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*
1 Jul 73											
74	166,378	6	3.6	16	9.6	4	2.4	174	104.6	200	120.2
30 Jun 74											
1 Jul 74											
75	131,012	5	3.8	10	7.6	8	6.1	188	143.5	211	161.1
30 Jun 75											
1 Jul 75											
76	97,130	6	6.2	3	3.1	4	4.1	183	188.4	196	201.8
30 Jun 76											
1 Jul 76											
7T											
&	113,346	2	1.8	10	8.8	2	1.8	203	179.1	217	191.4
31 Jul 77	77**										
TOTAL	507,866	19	3.7	39	7.7	18	3.5	748	147.2	824	162.2

*Per 100,00 flying hours

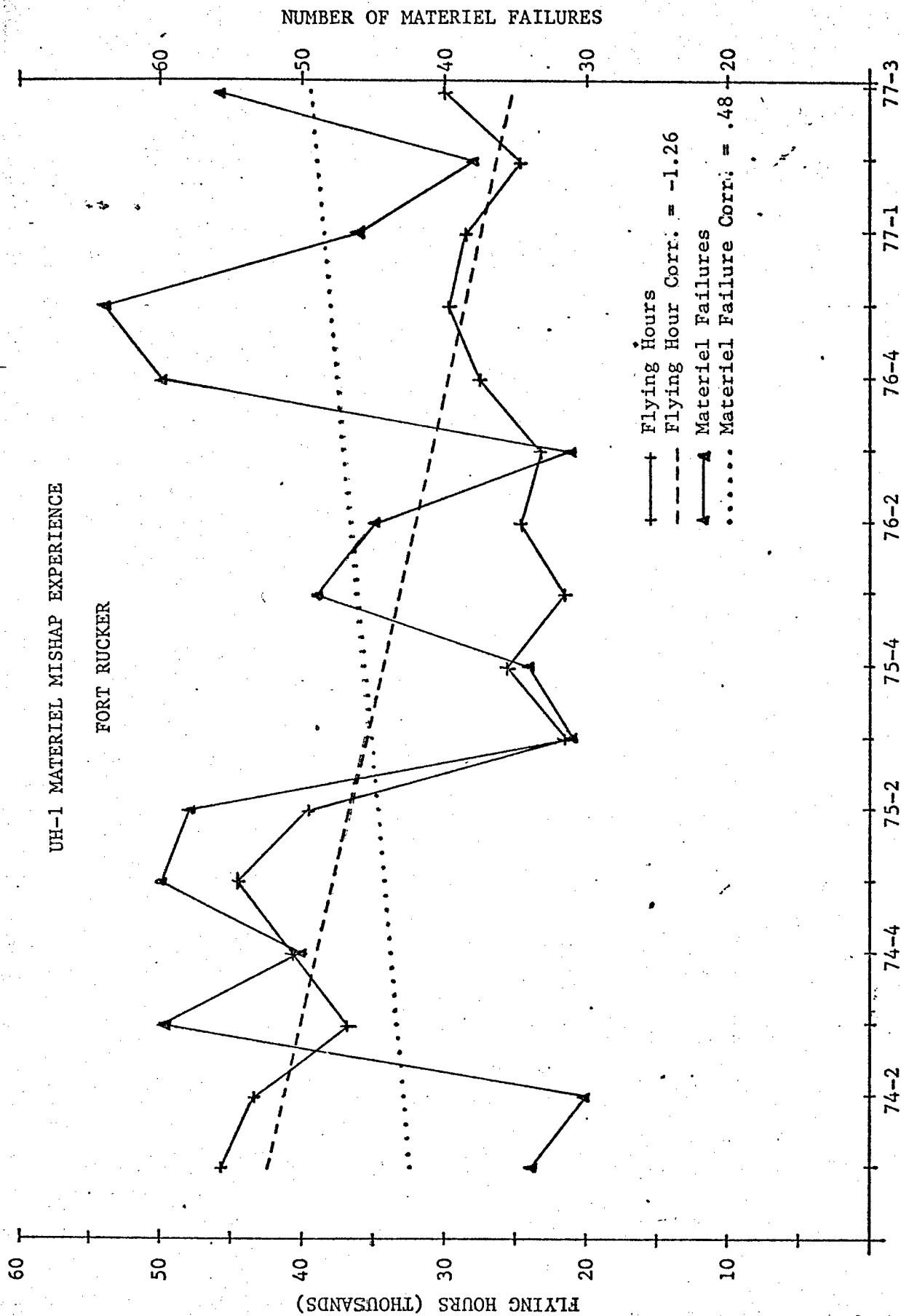
**July 77 was added to 7T and 1st 3 quarters FY 77 to reflect most recent experience

TABLE 4

System	Nomenclature	Total # Malfunctioned	% PL	FSN	Part #	# Ind Part
Hydraulic	Pressure Switch	91	13%	5930-00-646-3495	2040760571	91
Electrical	Battery	48	7%	6140-00-753-2251	MS244981	48
Hydraulic	Servo Cylinder	35	5%	1650-00-014-2038 1650-00-183-4426	2040760531 2050760387	18 17
Fuel System	Fuel Pump, Submerged	55	8%	2915-00-166-0234 2915-00-012-8684 2915-00-018-0012 2915-00-996-2169 2915-00-999-3705 2915-00-912-4522 2915-00-903-1202 2915-00-017-9021	2050606063 2050606075 R612240D 2040606279 2050606063 2050606065 60351B 164A168	16 14 10 6 4 2 2 1

UH-1 MATERIEL MISHAP EXPERIENCE

FORT RUCKER



FISCAL YEARS

Figure 1

UH-1 MATERIEL MISHAP EXPERIENCE

OTHER THAN FORT RUCKER

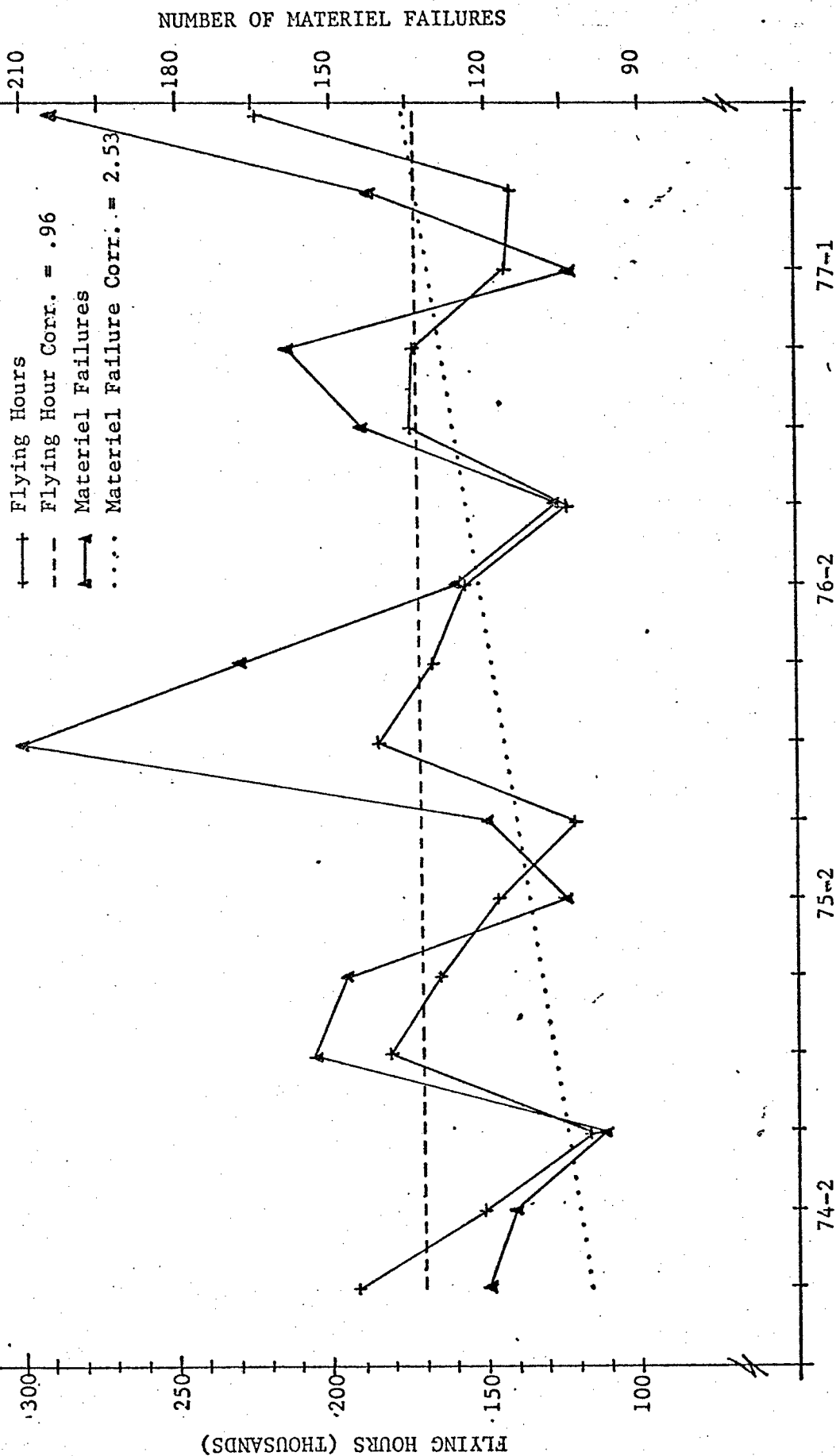
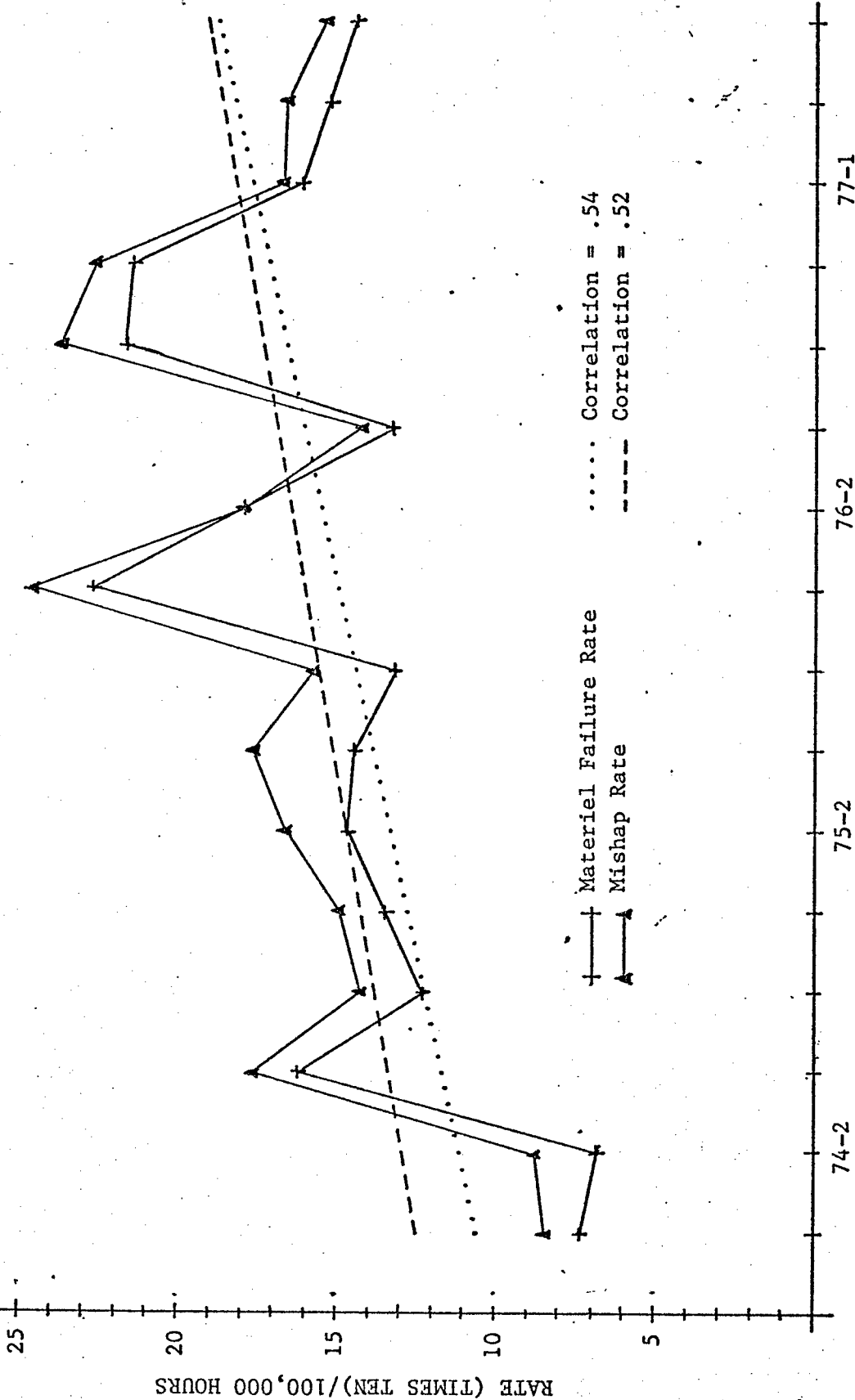


Figure 2

UH-1 MATERIEL MISHAP RATE

FORT RUCKER



FISCAL YEARS

Figure 3

UH-1 MATERIEL MISHAP RATE

OTHER THAN FORT RUCKER

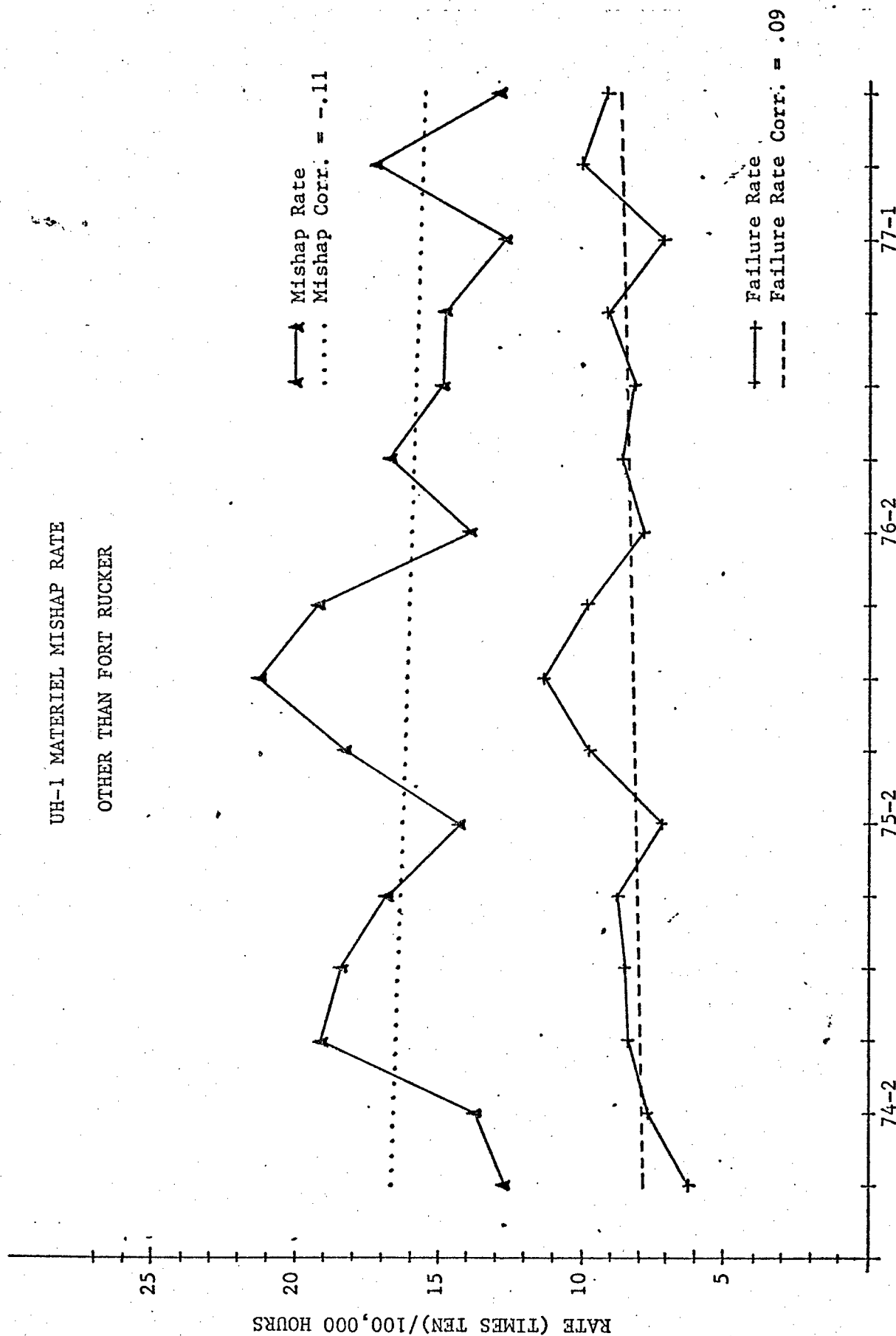


Figure 4

UH-1 MATERIEL MISHAP EXPERIENCE
 HYDRAULIC MALFUNCTIONS/FAILURES RATE
 FY74-1 TO FY77-3
 FORT RUCKER (USARVNS)

CORRELATION R = -0.04

FAILURE RATE (TIMES TEN)/100000 HRS

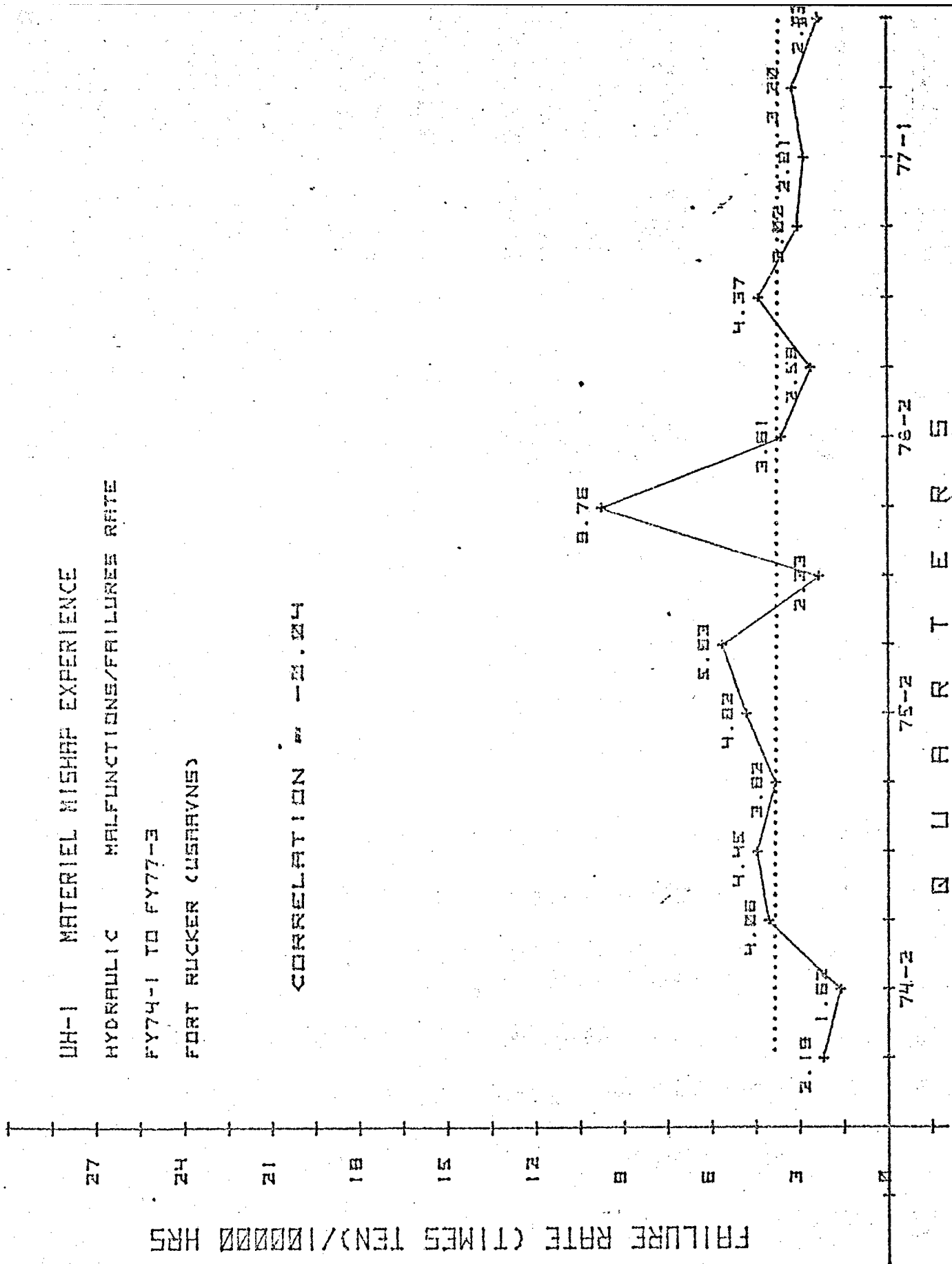


Figure 5

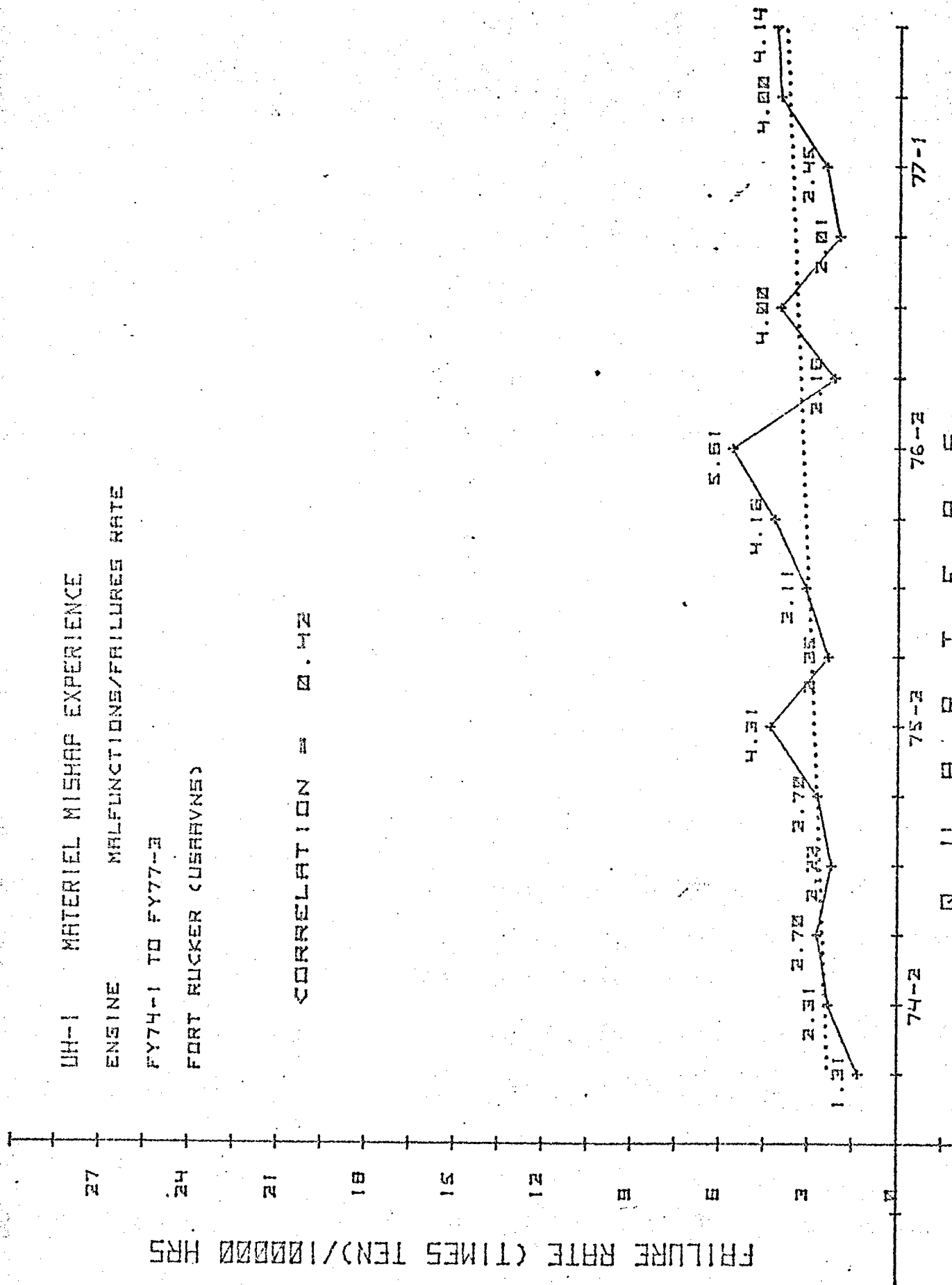
FAILURE RATE (TIMES TEN)/100000 HRS

UH-1 MATERIEL MISHAP EXPERIENCE
 ENGINE MALFUNCTIONS/FAILURES RATE
 FY74-1 TO FY77-3
 FORT RUCKER (USARVNS)

CORRELATION = 0.42

U H A R T E R S

Figure 6



UH-1 MATERIEL MISHAP EXPERIENCE
ELECTRICAL MALFUNCTIONS/FAILURES RATE
FY74-1 TO FY77-3
FORT RUCKER (USARVNS)

CORRELATION = 0.99

FAILURE RATE (TIMES TEN)/100000 HRS

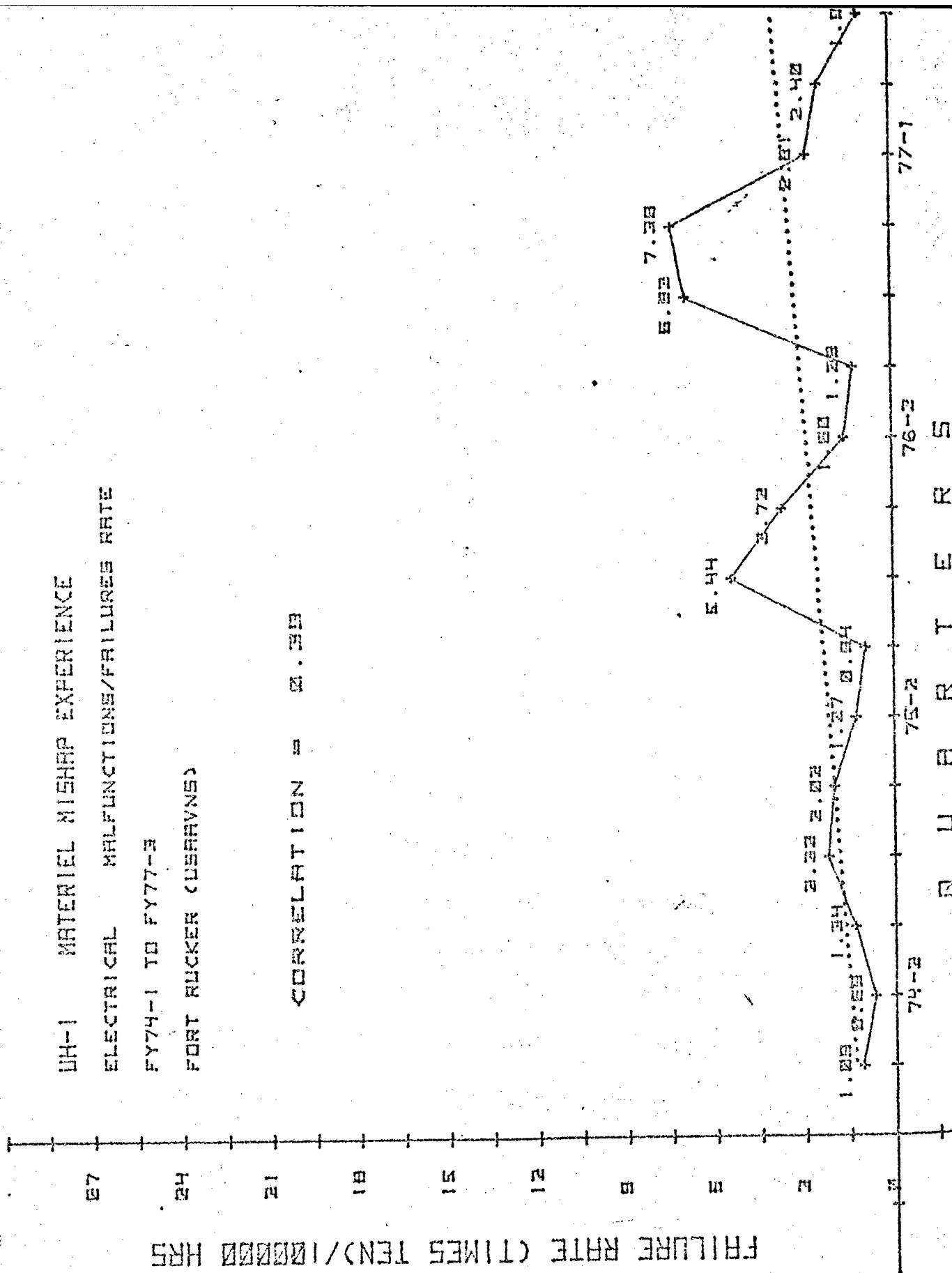


Figure 7

UH-1 MATERIEL MISHAP EXPERIENCE
 ROTOR/TRANS MALFUNCTIONS/FAILURES RATE
 FY74-1 TO FY77-3
 FORT RUCKER (USARVN)

CORRELATION = 0.40

FAILURE RATE (TIMES TEN)/100000 HRS

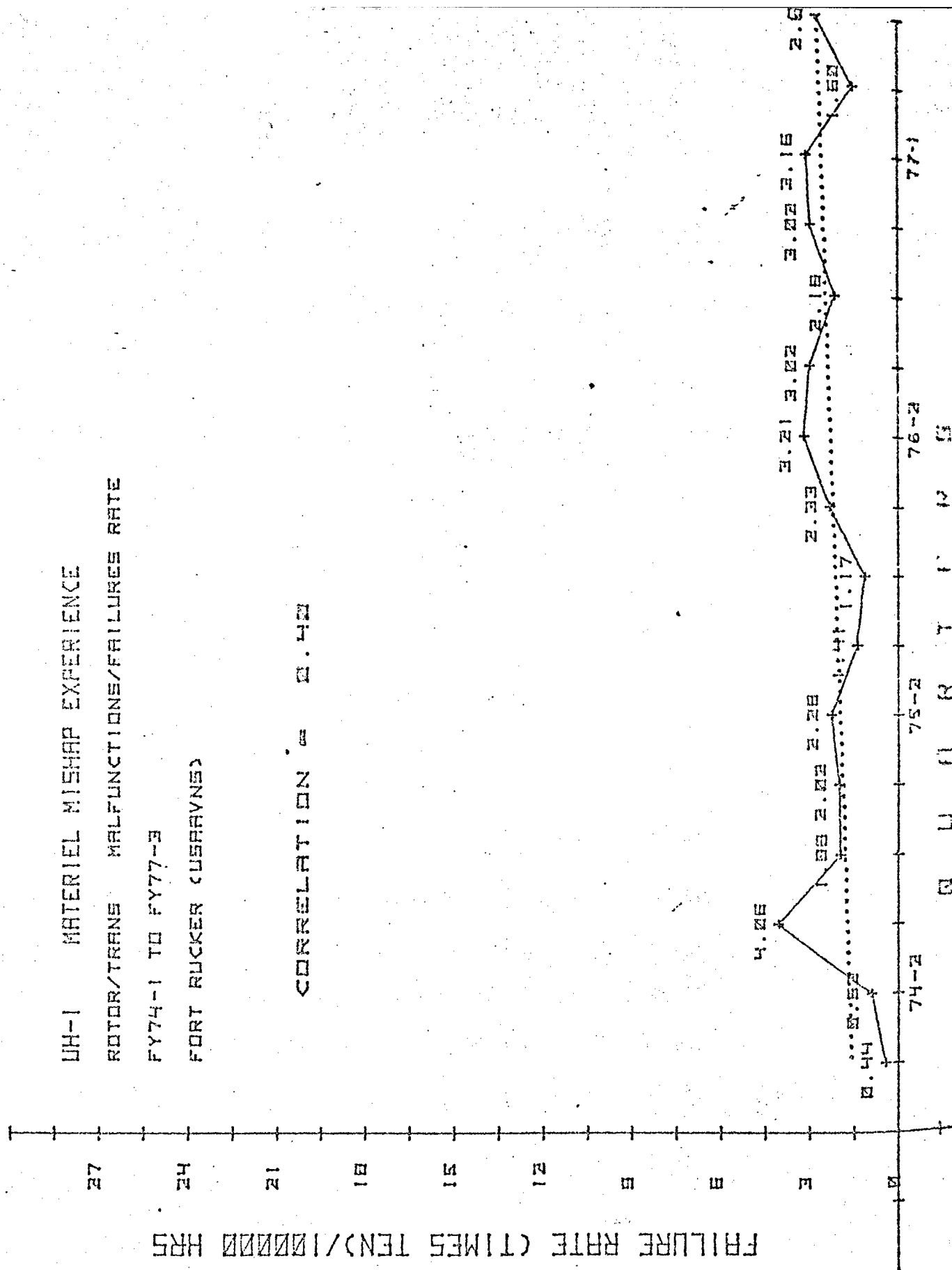


Figure 8

FAILURE RATE (TIMES TEN)/100000 HRS

UH-1 MATERIEL MISHAP EXPERIENCE
FUEL SYSTEM MALFUNCTIONS/FAILURES RATE
FY74-1 TO FY77-3
FORT RUCKER (USARVNS)

CORRELATION $r = 0.73$

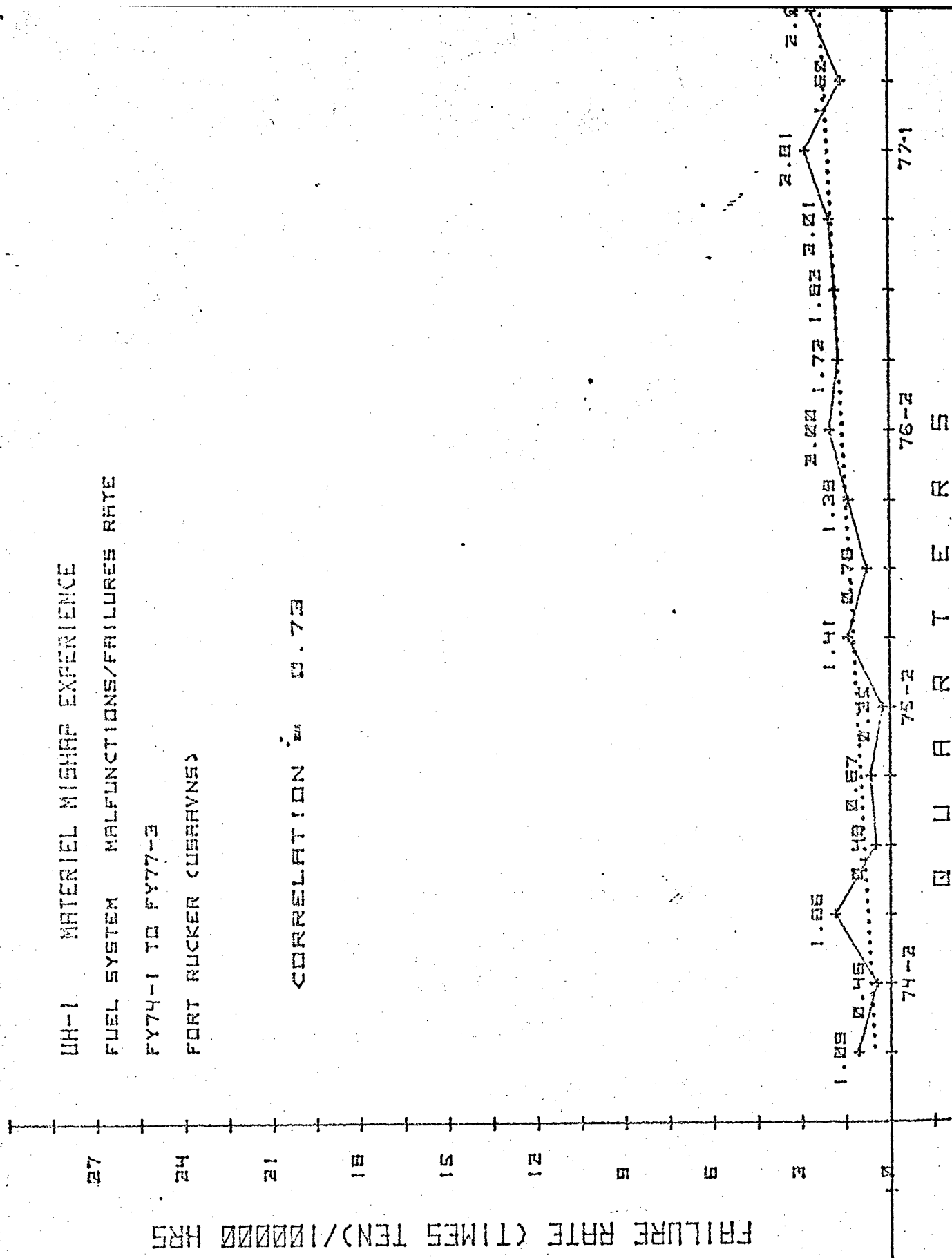


Figure 9

UH-1 MATERIEL MISHAP EXPERIENCE

INSTRUMENTS MALFUNCTIONS/FAILURES RATE

FY74-1 TO FY77-3

FORT RUCKER (USARVNS)

CORRELATION = 0.46

FAILURE RATE (TIMES TEN)/100000 HRS

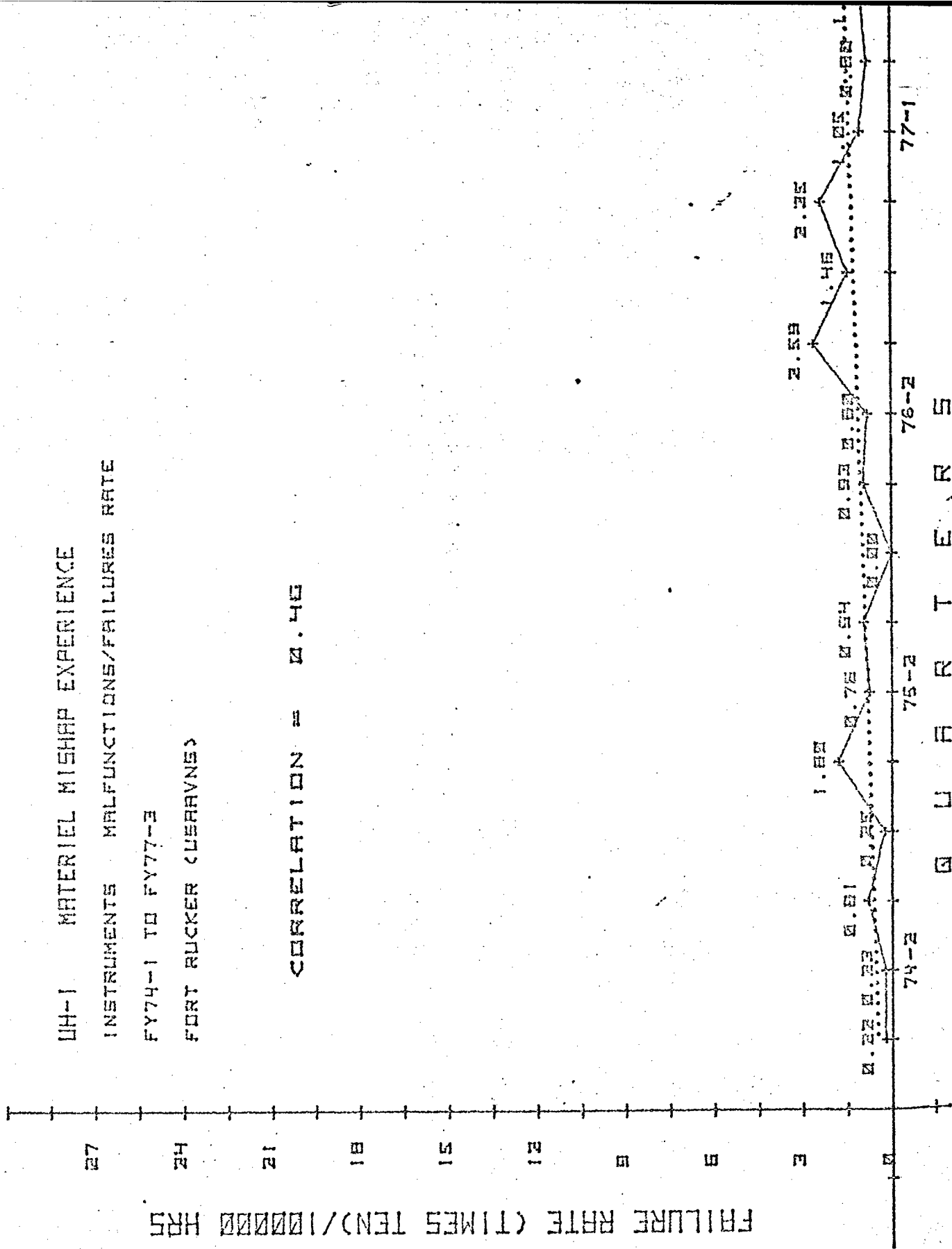


Figure 10